

Coatings
Corrosion
Fracture and Mechanical Testing
High Temperature Mechanical Properties
Hydrogen Production and Storage Materials
Hydrogen Separation Materials
Irradiation
Materials Validation
Microstructure and Physical Properties
Modeling
Neutron Radiography
Nondestructive Evaluation
Post-irradiation Examination
Synthesis and Processing of Novel Materials
Welding and Joining
X-Ray Radiography

Materials Capability Summary

The Idaho National Laboratory has broad materials science and engineering capability related to the nuclear energy mission—from fabrication and testing of nuclear fuel, specification, validation and fabrication of structural materials, to nuclear waste forms and packaging. About 75 scientists and engineers carry out materials development and engineering at the laboratory. Approximately 50 have advanced degrees.

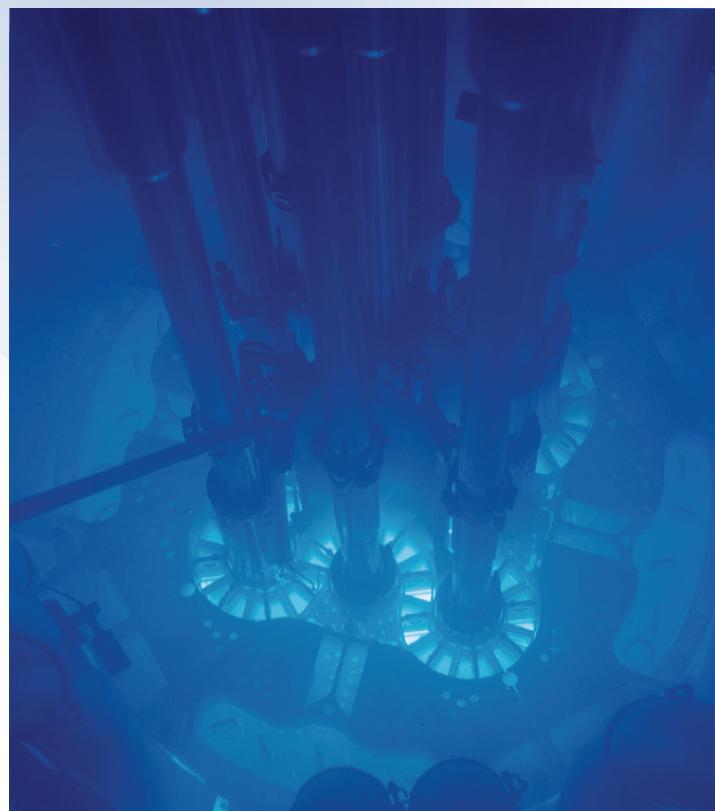
The materials science and engineering facilities are primarily located at the Materials and Fuels Complex (MFC), the INL Research

Center (IRC) and the Reactor Technology Complex (RTC). Major facilities include the Hot Fuel Examination Facility (HFEF) at MFC and its associated analytical laboratories. The IRC has about 24 laboratories dedicated to materials characterization, property characterization and welding. The RTC includes the Advanced Test Reactor (ATR), a unique national resource for irradiation testing of fuel and materials, as well as facilities for isotope production. Cross cutting support exists several places at the Laboratory in numerical simulation, engineering testing of prototype

structures, and validation of material performance and ASTM code qualification.

The HFEF is a critical part of a large capability to design, fabricate and conduct post-irradiation examination on nuclear fuel. Capabilities at MFC are unique in the world and represent an enormous capital investment. Characterization methods for irradiated materials include neutron and X-ray radiography, analytical chemistry for composition and phase structure, transmission electron microscopy, and determination of physical properties. Advanced ceramic and metallic fuels have been developed and tested using these facilities.

The IRC houses sophisticated elevated temperature mechanical testing and fracture mechanics laboratories, as well as facilities for advanced methods of testing materials behavior in a variety of aggressive environments of interest to the nuclear cycle. World-class capabilities in weld design, modeling and automation have been developed here for large-scale fabrication including seal welds for storage casks for Yucca Mountain. Parallel world-class capability has been developed for thermal spray deposition of advanced coatings. Unique methods of non-contacting laser ultrasonic inspection have been developed and implemented for in situ measurement of test specimens in the Advanced Test Reactor.



The Advanced Test Reactor at the RTC is widely considered to be the nation's premier test reactor. This photo looks down into the reactor core.

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The IRC has 24 materials laboratories. The high-resolution phase-shifted moiré interferometry system, shown here with an Instron load frame, provides localized displacement data for fracture research.

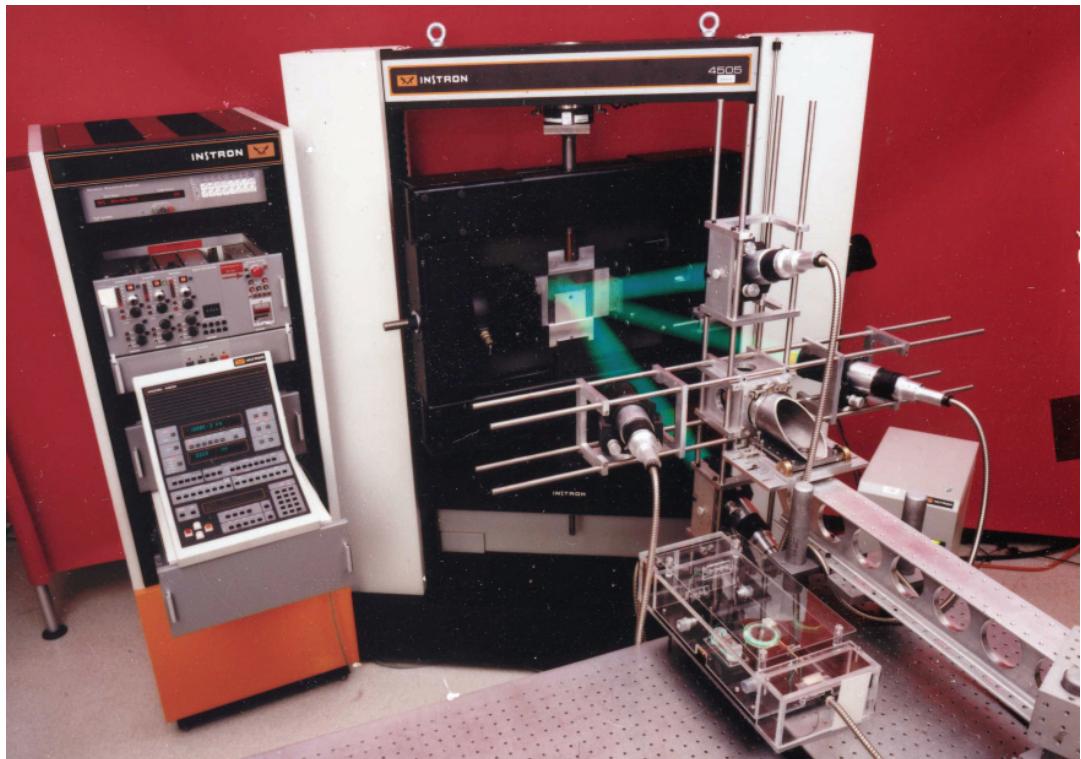
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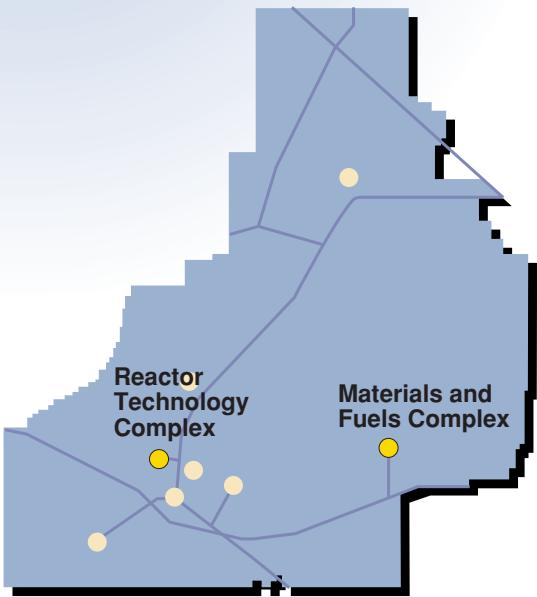
www.inl.gov/env-energy-science/materials

INL is a U.S. Department of Energy national laboratory operated by Battelle Energy Alliance



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The Advanced Test Reactor is the third generation test reactor built at the RTC to study the effects of intense neutron and gamma irradiation on nuclear fuel and structural materials. ATR has maximum power of 250 MW and maximum thermal neutron flux of 1×10^{15} neutrons/cm²s. ATR has a wide range of experimental facilities and the ability to vary the neutron flux in different areas of the core, allowing numerous experimental conditions during the same reactor operating cycle. New experiment stations accommodate up to fifteen different tests each with its own temperature control and spectral tailoring.



Map of the INL showing the locations of the Reactor Technology Complex and Materials and Fuels Complex.